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TUNGSTEN ORES
IN
SOUTH AFRICA
WITH
SPECIAL REFERENCE TO
NAMAQUALAND
AND
THE ORANGE RIVER

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TUNGSTEN ORES IN SOUTH AFRICA, WITH SPECIAL REFERENCE TO NAMAQUALAND AND THE ORANGE RIVER

by

G. K. JOUBERT, B.SC.

I. GENERAL

Introduction

A short summary of tungsten occurrences is given in "The Mineral esources of the Union of South Africa". The aim of the present account to draw further attention to the possibilities of a strategic mineral now ing eagerly sought under war stimulus and for which a good demand is expected persist, even after the conclusion of the present international conflict. New velopments as regards discoveries and methods of prospecting are here given.

Use

The trend of modern engineering industry has been towards the utilisation harder and still harder metal alloys. To work and machine such material quires an even harder alloy in the machine tools. Tungsten alloys, next to dustrial diamonds, satisfy this need. Ferro-tungsten steels are extremely ard and can be operated at high speed at red heat without the danger of eakdown in their metallurgical constitution. The speedy mass-production ethods of the present day have become dependent on an adequate supply this tool steel. It will be appreciated that, even after the cessation of stilities when the industrial world will have to be reorientated on a peace sis, the big demand for tungsten will remain and the price is likely to maintain level higher than the pre-war, if not at the present peak value.

The use of tungsten in electrical apparatus is well-known. A new use, so likely to make increasing demands on the mineral supplies of the future, its replacement of lead in the preparation of good paints when a non-poisonous aterial is essential.

The United States of America is to-day the biggest consumer of the ore , besides satisfying its own industrial requirements, it supplies other untries with the manufactured tool steels. Apart from the high consumption casioned by armaments production, the ore is regarded as of first strategic portance in the building up of stock piles. The United States cannot supply own needs from home resources, as indeed none of the present big industrial untries can do. Pre-war competitive prices ranged around about 50s. per nit, i.e., about £160 per long ton assaying 65 persent WO_3. The present rice is more than double, about £380, obtainable in America, the British control aving released most of its purchasing rights in favour of America.

Supplies

China and Malaya used to be the largest suppliers of the ore. Part of e Chinese field of production is now under Japanese control, while ore still eing exported has to travel by devious routes exposed to attack. The Malayan roduction has decreased considerably in recent years. Hence old fields, ll lately completely or partially abandoned, have been revived, e.g., in ustralia and United States. New discoveries in Portugal are already roductive. In Southern Rhodesia the limited production has dropped omewhat lately. Old Transvaal mines, like those of the Mutue Fides- Stavoren nfields, Murchison Crown, Stromboli and Forbes Reef where the ore has been nown for a long time, have not yet received renewed attention. Along the anks of the Orange river, i.e., in Gordonia, Kenhardt, Namaqualand districts and in South West Africa, the latest activity is showing good results. In the Union this field is the most extensive over which the ore occurs consistently, if not always in payable quantity. "Payability", however, is difficult to judge from a mere examination of the ore content, nor have the methods of exploitation followed thus far helped much in establishing an approximate pay margin for purposes of proper mining. It can be said, however, that prospectors generally work at profit in spite of their crude methods.

II. THE ORANGE RIVER AND NAMAQUALAND FIELD

History and Methods of Development

Before 1935 small collections of scheelite were made in the Steinkopf native reserve, while wolframite was known to exist in the Gordonia district, just north and west of the Aughrabies falls. The Tham Hamma Syndicate prospected and recovered scheelite from the Groendoorn river, a gorge cut into the Neintnababeep plateau N.W. of Steinkopf. The work of collecting is mostly done by local natives in the Reserve, where the mineral rights are still vested in the Crown. The natives remove the easily recoverable ore from near the surface. By handpicking, cobbing and washing, this ore is brought up to about a 40 per cent. WO_3 content, is sold to local dealers in this form and is then reduced at the stores to a marketable concentrate of 60–70 per cent.

Local traders now take an active part in the development, or rather the prospecting, of the ore. They stake their own claims on which a large gang of native men and women is employed under white supervision. Only elementary methods of winning the ore are applied. The work pays the trader in so far that he gains a small return above working costs out of the ore itself, that he does profitable trade with his own gang of natives and that he has opportunity for opening up good deposits for further speculation and unhampered by prospecting costs.

Small syndicates also operate, some with the intention of testing the ore only for speculative purposes, while others profit directly from their recoveries. These also supply their workers with their daily requirements in trade material but further adopt a 'tribute' or 'contract' method. By this the native is permitted to prospect at indicated sites on the syndicate holdings. His blasting is supervised by the syndicate while he receives other help. Exactly how he spends his energy is his own business, though the syndicate retains the right to terminate his contract should his labour be unsatisfactory. The crude ore he produces is sold to the syndicate at a prearranged price.

One small mine is operating in Gordonia district, north of the river. Some farmers employ their labour during slack times in farming to prospect tungsten ores.

By these elementary methods it has not been difficult in the past to produce 100 tons or more of good concentrate per annum over the whole area. Under the enhanced price of the day, considerable extension of activity can be anticipated. This has already taken a stride forward although the results are not yet reflected in the last quarterly official returns published.

Productive Area

Until recently, production has mostly been scheelite ore from the Steinkopf reserve and from the private holdings near Goodhouse; wolframite ore from the farms in the neighbourhood of Dabaras, Kenhardt district and from Collinskop mine across the river in Gordonia district. During the past six months the field of search has extended eastwards and southwards. New finds are being devoloped at Rhenosterkop, one of the Kakamas river settlements and at

Dyasonsklip, fourteen miles west of Upington. Towards the south, several new places are being opened up within the copper field round O'okiep. The latest geological research is steadily proving the existence of tungsten ores between the widely separated points mentioned. The purely accidental manner of the new finds, made by boys who have had former experience in handling the ore at older sites, would indicate that the possible occurrences on the surface are not all known yet. The geological indications even go much farther afield: southwards for sixty miles to Garies ; eastwards of Upington for 100 miles to Prieska. It is certainly worth remarking that, although the area round O,okiep has had such a long history in mineral development, the plentiful tungsten ores there have only just become known.

A pleasing feature now is that a start is being made towards the proper development of tungsten ores under adequate capital control. The extensiveness of the total field of known occurrences (250 miles from Upington to Steinkopf, 60 miles from Goodhouse to O'okiep) together with the facts that prospecting for tungsten ores is still in its infancy, that the area is remote and poorly known by larger mining concerns and that travelling and living conditions in the area still require much improvement, have till lately deterred capital interest. Certain enterprise now launched entertains the justifiable hope of being able to lift the winning of tungsten ores above the mere surface prospecting stage.

III. GEOLOGY AND MINERALOGY

Country Rocks

Along the banks of the Orange river are complex granitic intrusions of slightly differing ages but all of 'basement granite' order. These invade older material, the original nature of which is only partially understood. The country therefore can be described, geologically, as a vast 'contact metamorphic' area. One of the youngest granites had a strong aftermath of pegmatites accompanied by the deposition of economic minerals. The mineralisation is, consequently, of the 'high temperature' range, the gangue material being actually still granite at times. The numerous inclusions of older rock, now appearing as elongated schistose bands in the granite, have formed the main channels within which pegmatitisation and mineralisation took place. This applies especially to the O'okiep locality where the original sedimentary nature of the xenoliths is still apparent. Elsewhere the nature of the xenoliths is not so clear ; some were argillaceous and arenaceous sediments, some dolomitic, some of volcanic origin, all now recrystallised with the addition of granitic material. Still other channelways are shear zones, now filled with biotite schist, cutting through some crystalline rock types older than the mineralising granite. Garnetised and epidotised 'hybrid' rocks which retain vestiges of stratification are favourite repositories of tungsten ores. In such, numerous thin but parallel ore-bearing quartz veins and pegmatite lenticles occur. The gangue of the tungsten veins is usually quartz with very little other pegmatite base. Where the ore appears to be in normal pegmatite, or even in granite, an obscured vein quartz devolopment must be suspected. The very numerous 'normal' pegmatites carry a variety of economic minerals but are not normally favoured by tungsten minerals. Minor quantities of fluorspar and molybdenite may be found within tungsten veins.

Distribution of Veins

Along the strike of an ore zone, the productive parts are usually lenses and pockets. Some veins may bulge or pinch out on a single continuous plane marked by signs of fracturing. Others become scattered as numerous thin lenticles within a limited width of country rock. In garnetised schist zones, the prospector will rather follow the thin lines indicating reconstituted fracture material than actual quartz as here the ore tends to segregate into lumps clearly separated from its gangue but confining itself to the indicator plane.

In its wider distribution, the ore may be found over the whole of a farm, or over a base mineral claim, in numerous small occurrences. The method in vogue for working such scattered deposits has been mentioned, but such manner of attack also implies that no ore shoot is properly followed to its logical conclusion. Thus, wherever a number of small workings is opened, it remains an open question how many of them could ultimately be joined up, along definite strike lines, into continuous ore-bodies payable on application of efficient methods of concentrating low grade material. Several occurrences are already known to be of sufficient size individually to warrant small mining operations. The latest finds near O'okiep indicate the possibility of large-scale low-grade mining enterprise. Here the xenolithic inclusions in the granite-gneiss are clearly defined bodies carrying lenticular ore veins throughout their entire widths and in sufficiently dense distribution to become a mineable ore, together with massive lumps of ore associated with occasional quartz blows and recrystallised quartzite masses.

Genesis of Ore

So far this account has mostly used the expression ' tungsten ores ', but it can now be pointed out that the minerals wolframite and scheelite are not indiscriminately mixed up over the whole tungsten-bearing field. Portions of the field produce only one of the two minerals. A scheelite portion will have only scheelite, but a wolframite portion may consistently show the presence of small quantities of scheelite. In the few localities where there appears to be a definite overlap, a ' mixed ' ore results. Here, from the order of crystallisation, it would appear that during a first stage of tungsten mineralisation the whole field received the mineral scheelite but that at a later stage a strong influx of iron and manganese solutions affected parts of the field so as to replace the calcium in the scheelite by iron and manganese, thus converting scheelite into wolframite. In ' mixed ' ores then, the scheelite exists as cores within larger lumps of wolframite. Excess iron solution occasionally resulted in the total replacement of scheelite and the deposition of iron ores together with wolframite. Instances are known where only iron and manganese deposits were formed, suggesting that tungstic acid had never been present in such localities.

Associated Minerals

Deleterious associates of tungsten ores are found but rarely. One vein among a group of closely spaced veins carries arsenical sulphides. In the scheelite veins of Steinkopf reserve, copper may appear as an impurity. No case, however, is known where sellers have been penalised for any of the unwanted admixtures like arsenic, copper, phosphorus or tin. The almost complete absence of tin in wolframite deposits is to be noted as usually these two go together in other fields. At Kuilsriver, cassiterite and wolframite were once produced in almost equal proportions. The lack of tin in Namaqualand throws significant light on the replacement view given above.

ORE GRADES

Ore grades cannot be established by the usual assay sampling, but only on actual milling and recovery results, the distribution of the ore within the veins being too erratic. To quote an example : What appeared to have turned into a barren vein unexpectedly yielded a solid mass of pure scheelite weighing 2½ tons ! The new discoveries at O'okiep yield ore distributed in small grain within a host of veinlets, as also in large masses of very pure wolframite.

At the present price in the United States, an ore containing 1 per cent. WO_3 ($=1 \cdot 25$ per cent. scheelite mineral, $=1 \cdot 32$ per cent wolframite mineral) is worth £3. 16s. 0d. a ton and a $0 \cdot 10$ per cent WO_3 content is worth 7s. 7d. per ton. If sliming can be avoided in the reduction, at least 90 per cent should be recoverable by a series of wind-blowers, dry tables, wet jigs and wet tables. Production to date shows yields of well over 1 per cent., but these represent pickings from pockets only, the fines falling from the ' pocket ' ore not being taken into account, nor the ore of small grain distribution in the rest of the vein offering difficulties in hand sorting to the prospector. The one mine operating has used only crude hand methods of concentrating and is still recovering from ore formerly discarded as waste.

IV. FINDING THE ORE

SUGGESTIONS FOR PROSPECTORS

In searching for tungsten minerals, it is advisable to employ some of the local natives already experienced in handling the ore. Scheelite is difficult to spot among the many other light coloured granite and pegmatite minerals. Wolframite is a black heavy ore much resembling the ubiquitous heavy dark ores of iron, manganese, titanium and tantalum of the area. Even among experienced natives it is still common for them to recognise the one mineral and not the other if the two happen to be ' mixed ' in the correct tungsten ores. The high specific gravity of tungsten minerals causes them to be readily spotted in the pan. The poor usage of this prospector's friend in Namaqualand illustrates the extreme youth of prospecting for heavy minerals here. The diamond rotary pan and a dry blower have been applied with success in testing deposits of shed material.

ULTRA-VIOLET LIGHT FOR PROSPECTING SCHEELITE.

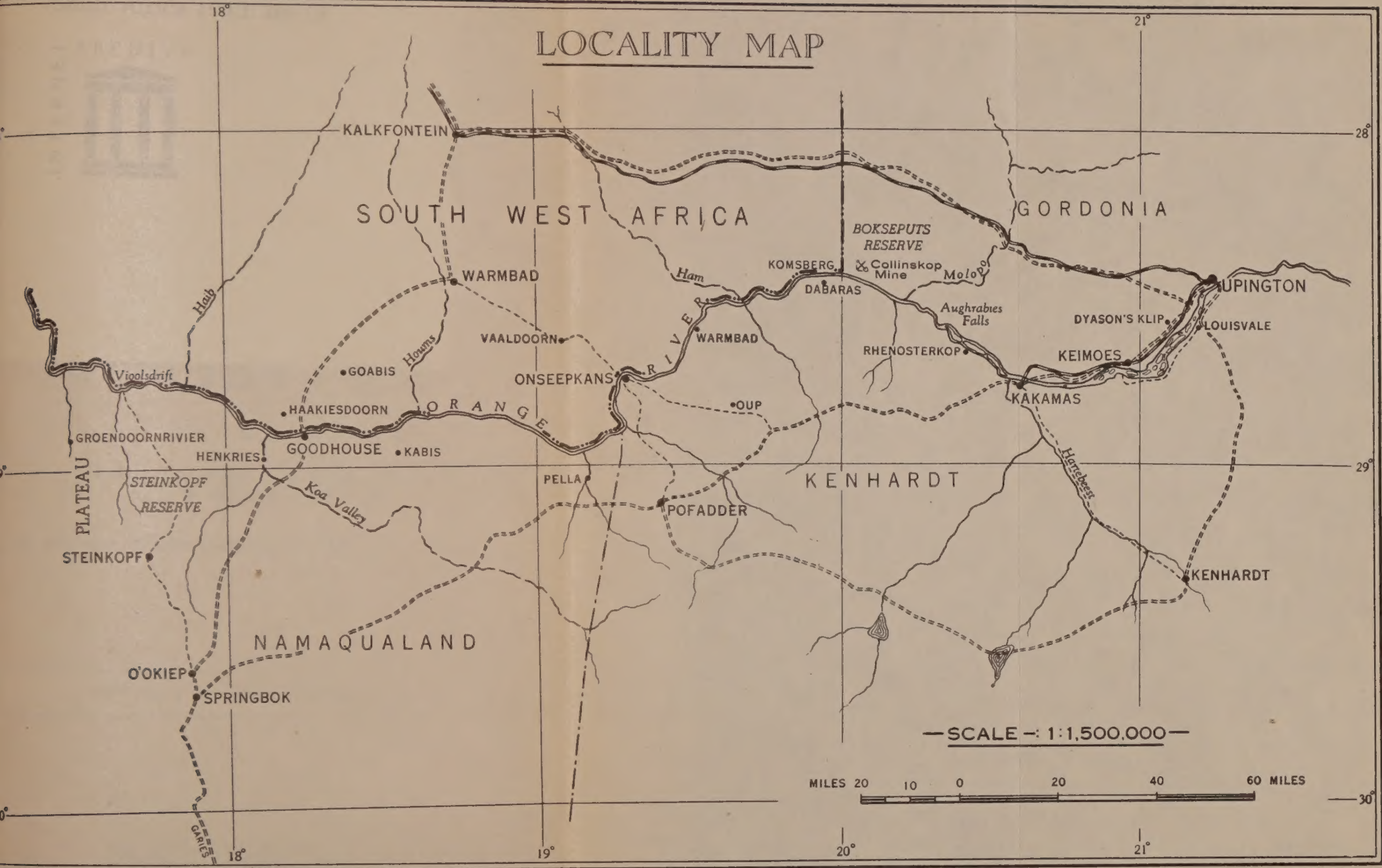
An effective way of finding scheelite has now become available. The mineral fluoresces strongly under the stimulation of carefully filtered ultra-violet light. The apparatus consists of a mercury arc in a specially bent quartz tube covered by the necessary filter plate, all arranged like a handy torch light. A small 6-volt re-chargeable battery supplies the electric current. The complete outfit weighs about 20 lb. so that it is easily portable, especially when the battery portion is arranged on a packboard strapped to the back. The lamp has an effective range of twelve feet over an area of 16 square feet. Among a wide variety of models for various purposes, some are adaptable to either high tension or low tension current. These are all a vast improvement on the old attempts to utilise the property of fluorescence in the recognition of minerals. When used in conjunction with a willemite plate, they can detect the presence of mercury to a one-thousandth per cent, it is claimed.

Tests carried out with ultra-violet lamp on South African ores have been positive to the utmost degree. Scheelite, when exposed at a surface, becomes apparant even when in its finest powdery form or in quantities that the assayist will merely record as ' trace '. Tests on ' waste ' dumps, i.e., on material discarded as not containing sufficient hand-sortable scheelite, have yielded the most spectacular results, indicating that not half the ore was recovered by the coarse methods employed.

For wider search, traverses at night will reveal any scheelite on the surface, whether *in situ* or as float, weathering having no obscuring effect on the fluorescence. The fluorescent response being instantaneous, large areas can be covered during a night's operation, or a long stretch of known scheelite-bearing zone can be checked up. As only the scheelite itself glitters in the ray to the exclusion of every other mineral the prospector has a visual means of estimating his ore right on the spot of occurrence. Application of the lamp has already led to the discovery of rich ore in finely disseminated form, a habit that escaped attention over more than six years of prospecting.

The use of the lamp in sorting broken ore and in keeping a continuous check on tailings will be readily appreciated. In any dry method of concentrating scheelite, stage-by-stage progress and efficiency can be literally visualised.

Wolframite itself does not fluoresce, but the small quantity of scheelite usually present can be used to indicate the run of a wolframite deposit.



LOCALITY MAP